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CERTIFICATION

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This is to certify that the above-stated document was translated by Martin Cross from Japanese into English, and that it represents an accurate and faithful rendition of the original text to the best of my knowledge and belief.

By:

December 17, 2007

Martin Cross is the president of Patent Translations Inc. and has worked for nineteen years as a Japanese to English translator and translation editor specialized in patent documents.

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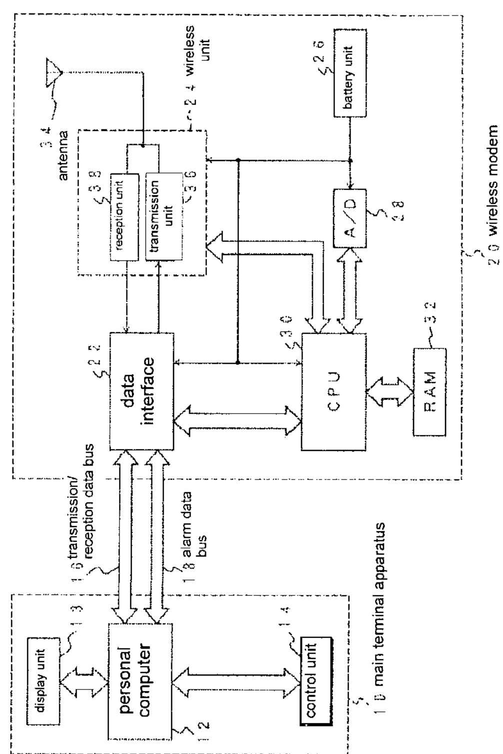
(33)	**Priority Country:**	Japan (JP)	(74)	**Agent:**	Patent Attorney, KYOMOTO, Naoki (and two more people)

(54) **[Title of the Invention]** Battery Level Detection Device

(57) **[Abstract]**

[Object] To provide suitable battery level information, according to different types of batteries that supply power.

[Constitution] Using a load curve plot corresponding to the type of battery, the battery capacity level is calculated in terms of remaining usable battery time, based on the detected power source voltage and the voltage at which the device ceases to operate properly. Using the calculated remaining usable battery time, the time for which the wireless device can receive and number of bits of transmission signal that can be transmitted are calculated and displayed. Furthermore, in the case of transmission problems such that transmission is not possible, the transmission signal is saved to a memory unit and the address of the saved transmission signal is displayed.



[CLAIMS]

[Claim 1] A battery level detection device characterized by comprising: specifying means for specifying the type of battery being used; and level detection means for detecting a battery capacity level on the basis of the type of battery specified.

[Claim 2] The battery level detection device recited in claim 1, characterized in that said battery capacity level is detected in terms of the time for which said battery can be used.

[Claim 3] The battery level detection device recited in claim 2, characterized by comprising transmission/reception means for performing signal transmission/reception, said level detection means detecting the amount of signal data that can be transmitted/received in terms of said battery capacity level.

[Claim 4] The battery level detection device recited in claim 1, characterized by comprising a display unit for displaying said battery capacity level.

[Claim 5] The battery level detection device recited in claim 1, characterized by comprising alert means for alerting the user to the fact that said battery capacity level is less than a predetermined level.

[Claim 6] The battery level detection device recited in claim 2, characterized by comprising display means for displaying said battery capacity level.

[Claim 7] The battery level detection device recited in claim 3, characterized by comprising display means for displaying said amount of signal data that can be transmitted/received.

[Claim 8] The battery level detection device recited in claim 7, characterized by comprising alert means for alerting the user to the fact that said amount of signal data that can be transmitted/received is less than a predetermined amount of data.

[Claim 9] The battery level detection device recited in claim 1, characterized in that said specification means comprise: voltage detection means for detecting a voltage value for said battery under at least two load conditions relating to said transmission/reception; and selection means for selecting the type of said battery that is being used, based on said detected voltage value.

[Claim 10] The battery level detection device recited in claim 9, characterized in that said detection means detect said battery voltage under first load conditions, in which both a transmission unit and a reception unit, which perform said signal transmission/reception are set to power ON, and under second load conditions, in which only a reception unit, which performs said signal reception is set to power ON.

[Claim 11] The battery level detection device recited in claim 9, characterized in that said specification means [*sic*] comprise calculation means for calculating the time until a predetermined voltage value is reached from one said detected voltage value, on the basis of said type of battery specified.

[Claim 12] The battery level detection device recited in claim 11, characterized by comprising transmission/reception means for performing signal transmission/reception, said level detection means detecting the amount of signal data that can be transmitted/received in terms of said battery capacity level.

[Claim 13] The battery level detection device recited in claim 3, characterized in that said transmission/reception means constitute a wireless modem connected to a data terminal apparatus.

[Claim 14] The battery level detection device recited in claim 10, characterized in that said transmission/reception means constitute a wireless modem connected to a data terminal apparatus.

[Claim 15] The battery level detection device recited in claim 12, characterized in that said transmission/reception means constitute a wireless modem connected to a data terminal apparatus.

[Detailed Description of the Invention]

[0001]

[Field of Industrial Application] The present invention relates to a battery level detection device, and more specifically relates to a device for estimating the battery level of a portable wireless modem and displaying the same.

[0002]

[Prior Art] In the past, such devices for estimating the battery level of a portable wireless modem and displaying the same have been disclosed, for example, in JP-04-036817-A (Reference Document 1).

[0003] Specifically, this document describes a battery pack provided with a current detection unit for detecting battery current and a voltage detection unit for detecting battery voltage. Furthermore, the battery pack is provided with a capacity detection unit that performs a predetermined time integration of the detected current values and voltage values and estimates the battery capacity level. Electronic apparatus connected to a wireless modem provided with a battery pack is provided with a display unit, and the estimated value for the battery capacity level is input from the battery pack and displayed.

[0004] As described above, electronic apparatus that is connected to a modem adopts a constitution wherein the estimated battery capacity level is displayed; accordingly, a user can observe that the battery capacity level displayed on the display unit is, for example, "60% level", and be aware of the time frame for changing the battery, based on the display on the display unit.

[0005]

[Problems to Be Solved by the Invention] However, in conventional devices for estimating battery level and displaying the same, while it is possible to display the battery capacity level, it is not possible to estimate items such as how much longer the battery can be used or how much more data can be transmitted/received by the wireless modem.

[0006] Furthermore, with an electronic apparatus connected to a wireless modem, because, in terms of batteries, each data modem is fitted with a different type of battery, such as a manganese battery, an alkaline-manganese battery or the like, it happens that the load curve characteristics differ for each type of battery, and there is a problem in that it is not possible to accurately estimate the battery capacity level.

[0007] An object of the present invention is to solve the problems described above and provide a battery level detection device that can estimate battery capacity level in terms of the amount of data that can be transmitted/received by the wireless modem, and that can accurately estimate

the battery capacity level according to the different types of battery that are fitted.

[0008]

[Means for Solving the Problems] In order to achieve the object described above, the battery level detection device according to the present invention comprises specification means for specifying the type of battery being used and level detection means for detecting the battery capacity level on the basis of the type of battery specified. This is configured so that the battery capacity level can be detected in terms of the amount of time for which the battery can be used and the amount of time for which the battery can be used can also be detected in terms of the amount of signal data that can be transmitted/received. Furthermore, the detected battery capacity level is displayed on a display unit.

[0009] Furthermore, the present invention is provided with alert means for alerting the user to the fact that the battery capacity level is less than a predetermined level.

[0010] Furthermore, in the present invention, the specification means comprise voltage detection means for detecting the battery voltage under at least two load conditions relating to transmission and reception; and selection means for selecting the type of battery that is being used based on the detected voltage value.

[0011]

[Operation] With the adoption of the constitution described above, the present invention detects battery voltage under two or more load conditions and finds detects [*sic*[1]] the voltage differential therebetween. The detected voltage differential is applied to load characteristic curves which have differing characteristics depending on battery type, and the type of battery being used is specified.

[0012] Furthermore, the level detection means detect the battery capacity level based on the detected voltage value and the load characteristic curve of the specified battery. Then, because the load characteristic curve was used in the detection thereof, the detected battery capacity level can be detected in terms of the amount of time for which the battery can be used; furthermore, the level detection means calculate the amount of data that can be transmitted/received on the basis of the amount of data in the transmission/reception signal, and display this on the display unit.

[0013]

[Embodiments] Next, the present invention will be described in detail with reference to the drawings.

[0014] FIG. 1 is a block diagram of a wireless modem and an electronic apparatus illustrating one embodiment of the present invention.

[0015] In the figure, a wireless modem 20 comprises a data interface 22, which exchanges signals with a personal computer 12 via a transmission/reception data bus 16 or an alarm data bus 18. The wireless unit 24 comprises a transmission unit 36 and a reception unit 38. The transmission unit 36 modulates a carrier wave with a transmission signal and transmits the modulated signal via an antenna 34. Meanwhile, the wireless unit [*sic*] 38 demodulates a reception signal received by the antenna 34 and outputs the demodulated signal. A battery is mounted in the battery unit 26, and power is provided to the wireless unit 24, the analog/digital converter (A/D) 28, the interface and the CPU 30. Note that, in terms of the supply of power to the transmission unit 36, power is only supplied when a transmission signal is input to the transmission unit 36. The A/D 28 converts the output voltage from the battery housed in the battery unit 26 to a digital voltage value. The CPU 30 calculates the battery capacity level based on the input of the digital voltage value in the manner described hereafter. Furthermore, the CPU 30 performs input processing of the digital voltage value and controls the wireless unit 24 in the manner described hereafter. Moreover, the CPU 30 exchanges data with a RAM 32, which temporarily saves the data.

[0016] The terminal apparatus main body 10 is provided with a display unit 13, which displays the specifics of the indications in the transmitted/received data. The control unit 14 sets the display on the display unit 13 and performs execution of the transmission/reception. Furthermore, signals are exchanged with the CPU 13 via the personal computer 12, the transmission/reception data bus 16 and the interface 22. The computer 12 is provided with a keyboard, which is not shown in the drawing, whereby commands are input by the user Next, the operations of the CPU 13 are described by way of FIGS. 2 to 7.

[0017] FIG. 2 is a flow chart that describes a method of detecting the power source voltage with the CPU 30.

[0018] In the figure, first, the load conditions for the wireless unit 24 are set to first predetermined load conditions (S101). Under the first load conditions, the wireless unit 38 is switched on and the transmission unit 36 is switched off. The wireless unit 38 is set to the first load conditions, whereafter the CPU 30 inputs the digital voltage value so as to detect the power source voltage (S102). The detected power source voltage is taken as the first power source voltage by the CPU 30 and stored in the RAM 32 (S103). Subsequently, the load conditions for the wireless unit 24 are set to second predetermined load conditions (S104). Under the second load conditions, the wireless unit 38 and the transmission unit 36 are switched on. Note that the load under the second load conditions is set to a greater load than under the first load conditions. The wireless unit 38 [*sic*] is set to the second load conditions, whereafter the CPU 30 inputs the digital voltage value, whereby the power source voltage value is detected (S105). The detected power source voltage value is taken as the second power source voltage value by the CPU 30 and stored in the RAM 32 (S106). The CPU 30 releases the wireless unit 24 from the second load conditions (S107) and sets the wireless unit 24 to the safety critical voltage value VT for the battery capacity level estimated from the first and second power source voltage values (S108). Note that the safety critical voltage value VT is explained hereafter. The CPU 30 compares the second power source voltage value and the safety critical voltage value VT (S109). In this comparison, when the second power source voltage value is greater than the safety critical voltage value VT, the CPU 30 stops power source voltage detection processing (End). Meanwhile, when the safety critical voltage value VT is greater than the second power source voltage value, the CPU 30 switches to alarm interrupt processing, which is described hereafter (S110).

[0019] Note that, in the embodiment described above, in S108, the CPU 30 compares the second power source voltage value and the safety critical voltage

[1] *There is an editing error in the original Japanese text, which is grammatically incorrect. -TRANS*

VT, but when the transmission unit 36 is switched off and the reception unit 38 is switched on, which is to say, when the wireless modem 20 is only performing reception operations, the CPU 30 executes a comparison of the first power source voltage value and the safety critical voltage value VT.

[0020] FIG. 3 is a flow chart describing a method for setting the wireless unit 24 transmission/reception time.

[0021] In the chart, first, the CPU 30 reads the first power source voltage value from the RAM 32 (S201). Furthermore, the CPU 30 reads the second power source voltage value from the RAM 32 (S202). The CPU 30 determines the type of battery unit 26 being used based on the voltage differential between the first and second power source voltage values, which were read (S203). In other words, as shown in FIG. 4, which is described hereafter, because batteries have differing load curve characteristics depending on their types, the CPU 30 can determine the type of battery from the voltage differential between the first and second power source voltage values. Subsequently, the CPU 30 reads the load curve plot, which was determined in S203, from load curve plots for each type of battery, which are stored in the RAM 32 (S204). Thereafter, the CPU 30 sets the wireless unit 24 to either the first or second load conditions, corresponding to subsequent processing by the wireless unit 24, which is to say, corresponding to either only reception processing or both transmission and reception processing (S205). Moreover, the CPU 30 inputs the digital voltage value and detects the power source voltage value of the battery unit 26 at the present point in time (S206). The CPU 30 estimates the remaining usable battery time as described hereafter based on the detected power source voltage value and the safety critical voltage value VT, which was determined from the load curve plot[2], which was read (S207). The estimated remaining usable battery time is stored in the RAM 32 and input to the control unit 14 via the interface 22 and the computer 12, and by way of the settings of the control unit 14, this is displayed on the display unit 13, once again via the computer 12 (S208).

[0022] FIG. 4 is a load curve plot for a battery, serving to explain the processing method in the flow chart shown in FIG. 3.

[0023] FIG. 4(A) shows a load characteristic curve for a battery having the characteristics of a manganese battery or similar, which is to say a battery having a high internal resistance. Meanwhile, FIG. 4 (B) shows a load characteristic curve for a battery having the characteristics of an alkaline-manganese battery or similar, which is to say a battery having a lower internal resistance than a manganese battery.

[0024] In both figures, VN indicates the provisionally assumed standard battery voltage value; and VT indicates the safety critical value for the power source voltage at which the wireless modem 20 can operate normally. VD indicates the power source voltage at which the wireless modem 20 ceases to be able to operate; VW1 and VW2 indicate the differences between the first and second power source voltage values, indicating the power source differential therebetween when the first power source voltage value under the first load conditions is at VN described above. TVN1 and TVN2 indicate the time at which the first power source voltage value reaches the aforementioned VN under the first load conditions, which is a time estimated from the load curve plot. TVT1 and TVT2 indicate the time at which the second power source voltage value reaches the aforementioned VT under the second load conditions, which is a time estimated from the load curve plot. Moreover, TL1 and TL2 are the times until the time TVT1 is reached from TVN1 and the time until the time TVT2 is reached from TVN2.

[0025] Note that, in the embodiment described above, because the load under the second load conditions is the maximum load on the wireless unit 24, the remaining usable battery time during which the wireless modem 20 can be operated normally before the battery is replaced is the shortest period of time, which is TL1, TL2, until the power supply voltage value reaches the safety critical value.

[0026] Once again in FIG. 3, in process S203, it is indicated that the battery type is determined by the CPU 30 on the basis of the differences between the first and second power source voltage values under the first and second load conditions; these voltage differences correspond to VW1 and VW2 in FIG. 4. In other words, the CPU 30 compares the difference between the first and second power source voltages and VW1 and VW2, or, while this is not shown in this embodiment, more [voltages] than this VWX (in which X = 3, 4, and so on) and determines the battery being used as that having the closest of the two values.

[0027] Furthermore, in processing S207, it is indicated that the remaining usable battery time is estimated by the CPU 30; to describe this estimation method in detail, the power source voltage values detected in S206 are written to the load curve plot, which was read in S 204. Note that TVN1 or TVN2 is overwritten at the time corresponding to this written voltage value. Furthermore, the CPU 30 calculates TL1 or TL2 on the basis of the overwritten TVN1 or TVN2 and TVT1 or TVT2, so as to estimate the remaining usable battery time. Note that, when the wireless unit 24 is set to the first load conditions, the remaining usable battery time is calculated based on the first power source voltage value when under the first load conditions.

[0028] Once again in FIG. 2, in S109, it is indicated that when the second power source voltage value is lower than the safety critical voltage, the alarm interrupt processing shown in S110 begins; when the wireless unit 24 is set to the first load conditions, the first power source voltage value when under the first load conditions is compared with the safety critical voltage value.

[0029] Next, the alarm interrupt processing is described using the flow chart shown in FIG. 5.

[0030] As described above, when alarm interrupt processing is requested, the CPU 30 saves the transmission/reception signal in the RAM 32 (S301). Subsequently, the CPU 30 outputs an alarm signal to the communicating wireless station, which is not shown in the drawing, and the control unit 14 (S302). When the response signals from the communicating wireless station and the control unit 14 are input to the CPU 30 (S303), the address of the transmission/reception signal that was saved in the RAM 32 is output to the communicating wireless station and the control unit 14 (S304). After the CPU 30 has output the address of the transmission/reception signal that was saved,

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[2] *This is a typographical error in the original Japanese, the literal translation of which would be "special tax map," rather than "plot," but an ordinary reader would immediately see that "plot" and not "special tax map" was intended.*

it ends the transmission/reception operations (S305) and sounds an alarm or lights an indicator (S306) as a prompt for the battery unit 26 power source to be replaced.

[0031] FIG. 6 is a flow chart describing the incoming connection operations with the communicating wireless station, which are performed by the CPU 30.

[0032] In the chart, when the wireless unit 24 receives the incoming signal via the antenna 34 (S401), the wireless unit 24 outputs an incoming signal response signal to the CPU 30. In response to the incoming signal response signal, the CPU 30 releases a mode serving to improve battery saving efficiency, to which the wireless modem 20 was set, which is to say the sleep mode (S402). Moreover, the CPU 30 outputs the incoming signal via the interface 22, the reception data bus 16 and the computer 12 (S403). Moreover, the CPU 30 inputs the digital voltage value from the A/D 28 (S404). As described above, the CPU 30 determines the type of battery by inputting the digital voltage value, and calculates the remaining usable battery time on the basis of the load conditions that are set for the wireless unit 24 (S405). Note that the incoming signal contains information that relates to the load conditions that are set for the wireless unit 24. The CPU 30 inputs a reception possible signal in response to the incoming response signal output by the control unit 14 (S406), and outputs the calculated remaining usable battery time to the control unit 14 (S407). Furthermore, the CPU 30 transmits the reception possible signal to the communicating wireless station via the transmission unit 36 and the antenna (S408). A reception signal that is transmitted from the communicating wireless station in response to the reception possible signal is input via the antenna 34 and the reception unit 38, whereupon the CPU 30 begins reception processing operations and the reception signal is output to the computer 12 via the transmission data bus 16 (S409).

[0033] FIG. 7 is a flow chart describing the outgoing connection operations performed with the communicating wireless station by the CPU 30.

[0034] In the figure, first, the CPU 30 inputs a transmission startup signal from the control unit 14 via the computer 12 and the transmission/reception data bus 16 (S501), whereupon the wireless unit 24 is controlled so as to be switched on (S502). Subsequently, the CPU 30 inputs the digital voltage value so as to detect the power source voltage value (S503), and temporarily controls the wireless unit 24 so as to be switched off, for the purpose of battery saving (S504). As described above, the CPU 30 determines the type of battery by inputting the digital voltage value, and calculates the remaining usable battery time on the basis of the load conditions set for the wireless unit 24 (S505). The CPU 30 outputs the remaining usable battery time to the control unit 14 in terms of the time during which transmission is possible, which indicates a transmittable transmission file size (S506). An outgoing connection request signal from the control unit 14, in response to input of the remaining usable battery time, is input by the CPU 30 (S507), the wireless unit 24 is once again controlled so as to be switched on (S508), and the outgoing connection request signal is transmitted to the communicating wireless station via the antenna 34 (S509). The response signal from the communicating wireless station, in response to the outgoing connection request signal, is input via the antenna 34 and the reception unit 38 (S510), and as a result, the CPU 30 outputs a transmission possible signal to the control unit 14 (S511). As a result of inputting the transmission possible signal, the control unit 14 outputs the transmission signal to the CPU 30 via the computer 12, the transmission/reception data bus 16 and the interface 22; and the CPU 30 transmits the transmission signal to the communicating wireless station via the transmission unit 36 and the antenna 34, and begins transmission processing operations.

[0035] FIG. 8 is a flow chart describing the operations of the control unit 14 for inputting the reception signal from the wireless modem 20.

[0036] In the chart, first, the control unit 14 inputs the incoming signal from the communicating wireless station via the transmission/reception data bus 16 (S601). As a result of the incoming signal being input, the control unit 14 sets the reception file for storing the reception signal (S602) and sets the computer 22 to the reception state (S603). Subsequently, the control unit 14 outputs a reception possible signal to the wireless modem 20 (S604). The control unit 14 inputs the remaining usable battery time (S605) and displays the period of time for which reception is possible and the fact that the reception signal is being received on the display unit 13 (S606). When the reception signal is input to the main terminal apparatus 10 via the transmission/reception data bus 16, the control unit 14 begins reception signal processing (S607).

[0037] FIG. 9 is a flow chart describing the operations of the control unit 14 for outputting the transmission signal from the main terminal apparatus 10 to the wireless modem 20.

[0038] The transmission startup signal that is input from the keyboard of the computer 12, which is not shown in the figure, is input to the control unit 14 (S701), whereupon a transmission startup request signal is output to the CPU 30 via the transmission/reception data bus 16 and the interface 22 (S702). Subsequently, the control unit 14 inputs the remaining usable battery time from the CPU 30 (S703), calculates the number of bits in the transmission signal that can be output to the wireless modem 20 (S704), and displays it on the display unit 13 (S705). If the transmission signal selected by the user is within the number of bits that can be transmitted as described above (S706), the control unit 14 outputs the outgoing connection request signal to the wireless modem 20 (S708). Meanwhile, if the number of bits that can be transmitted is exceeded, the control unit 14 generates an alert sound notifying the user that it is necessary to reduce the number of bits in the transmission signal or to replace the battery unit 26 (S708). As a result of inputting the transmission possible signal that is output by the wireless modem 20 in response to the outgoing connection request signal (S709), the control unit 14 starts transmission processing for the transmission signal (S710).

[0039] If the control unit 14 receives an interrupt request from the wireless less [*sic*] modem 20, the control unit 14 recognizes that the power in the battery unit 26 is insufficient. Here, the control unit 14 interrupt processing when an interrupt request has been received

is described using FIG. 10.

[0040] In the figure, first, an ARM interrupt signal requesting interruption is input from the wireless modem 20 (S801), whereupon the control unit 14 saves the transmission/reception signal that is undergoing transmission/reception processing to the RAM 32 (S802). Subsequently, the control unit 14 inputs the ARM data signal from the wireless modem 20 (S803), as a result of which the receiving unit 24 detects whether or not a transmission/reception signal was being transmitted/received (S804) and further detects whether or not the transmission unit 36 was transmitting a transmission signal (S805). If both S804 and S805 were YES, which is to say, when the interrupt processing is executed while the transmission unit 36 is transmitting a transmission signal, the control unit 14 stops the transmission operations of the transmission unit 36 (S806). The control unit 14 further displays a message to the effect of, "Wireless Modem Stopped" or "Replace Battery" on the display unit 13 (S807), and outputs an ARM data response signal to the wireless modem 20 (S808). The control unit 14 inputs the address of the transmission signal that was saved in the RAM 32 from the wireless modem 20 (S809) and controls the display unit 13 so as to display the file name, the destination and the address of the transmission signal that was saved (S810). Then, the control unit 14 waits for the next command input from the computer 12 (S811).

[0041]

[Effects of the Invention] As described above, the battery level detection device according to the present invention adopts a constitution wherein the estimated battery level is calculated in terms of the usable battery time, and therefore the user can accurately confirm the timeframe for replacing the battery by checking the battery usage time that is displayed, and is able to transmit a transmission signal that is within the range of the battery level, so as to prevent loss of the transmission signal.

[0042] Furthermore, because the present invention adopts a constitution wherein the battery level is estimated based on load curve characteristics, which are different for each type of battery, it is possible to accurately estimate the remaining battery level, even in electronic devices in which batteries of multiple different types can be mounted.

[BRIEF DESCRIPTION OF THE DRAWINGS]

[FIG. 1] is a block diagram of a wireless modem and a terminal apparatus main body, representing an embodiment of the present invention.

[FIG. 2] is a flow chart that describes a method of detecting the power source voltage of a battery by the CPU 30.

[FIG. 3] is a flow chart describing a method for setting the wireless unit transmission/reception time.

[FIG. 4] is a load curve plot for a battery, serving to explain the processing method in the flow chart shown in FIG. 3.

[FIG. 5] is a flowchart describing alarm interrupt processing by the CPU.

[FIG. 6] is a flow chart describing the incoming connection operations with the communicating wireless station, which are performed by the CPU 30.

[FIG. 7] is a flow chart describing the outgoing connection operations with the communicating wireless station, which are performed by the CPU 30.

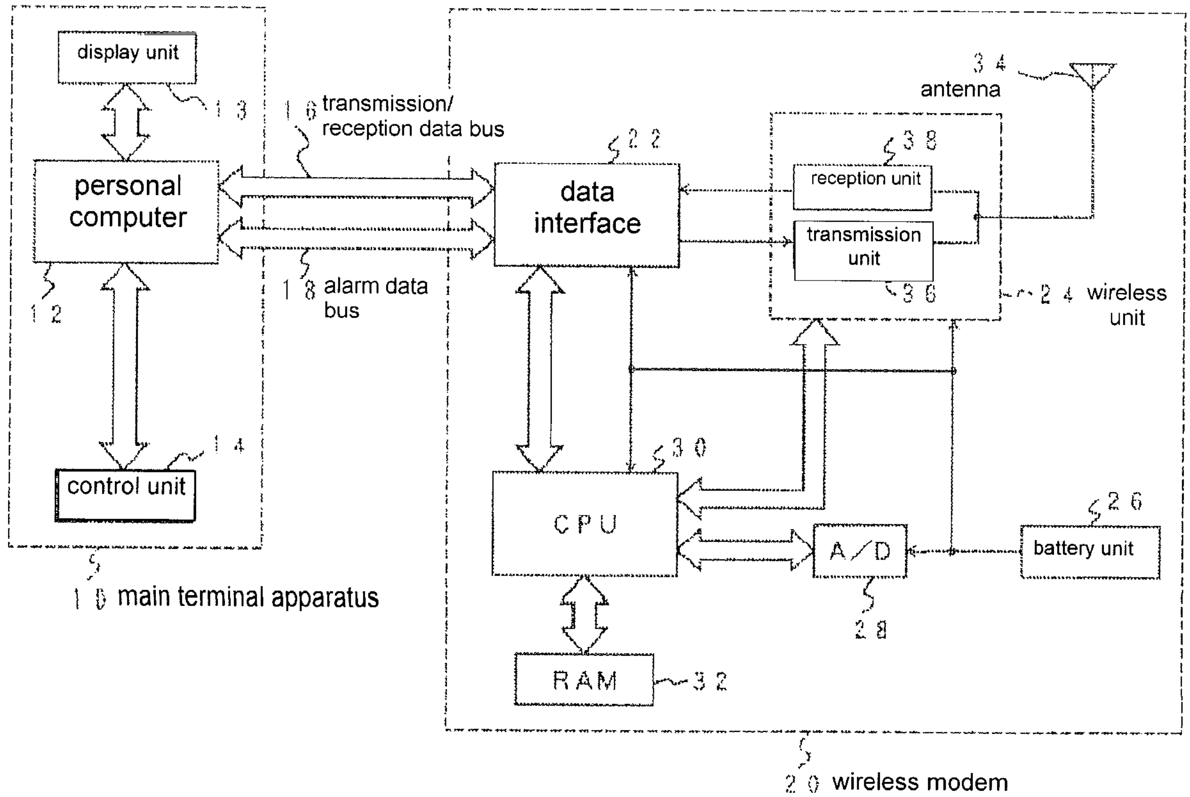
[FIG. 8] is a flow chart describing the operations of the control unit for inputting the reception signal from the wireless modem.

[FIG. 9] is a flow chart describing the operations of the control unit for outputting the transmission signal from the terminal apparatus main body to the wireless modem.

[FIG. 10] is a flow chart describing interrupt processing by the CPU.

[Explanation of the Reference Numerals]

10	terminal apparatus main body
12	personal computer
13	display unit
16	transmission/reception data [*sic*]
18	alarm data bus
20	wireless modem
22	data interface
24	wireless unit
26	battery unit
28	analog/digital conversion unit
30	CPU
32	RAM
34	antenna
36	transmission unit
38	reception unit



display unit
13
personal computer
12
control unit
14
10 main terminal apparatus
16 transmission/ reception data bus
18 alarm data bus
data interface
22
34
antenna
38
reception unit
transmission unit
36
24 wireless unit
30
CPU
A/D
28
battery unit
26
RAM
32
20 wireless modem

FIG. 2

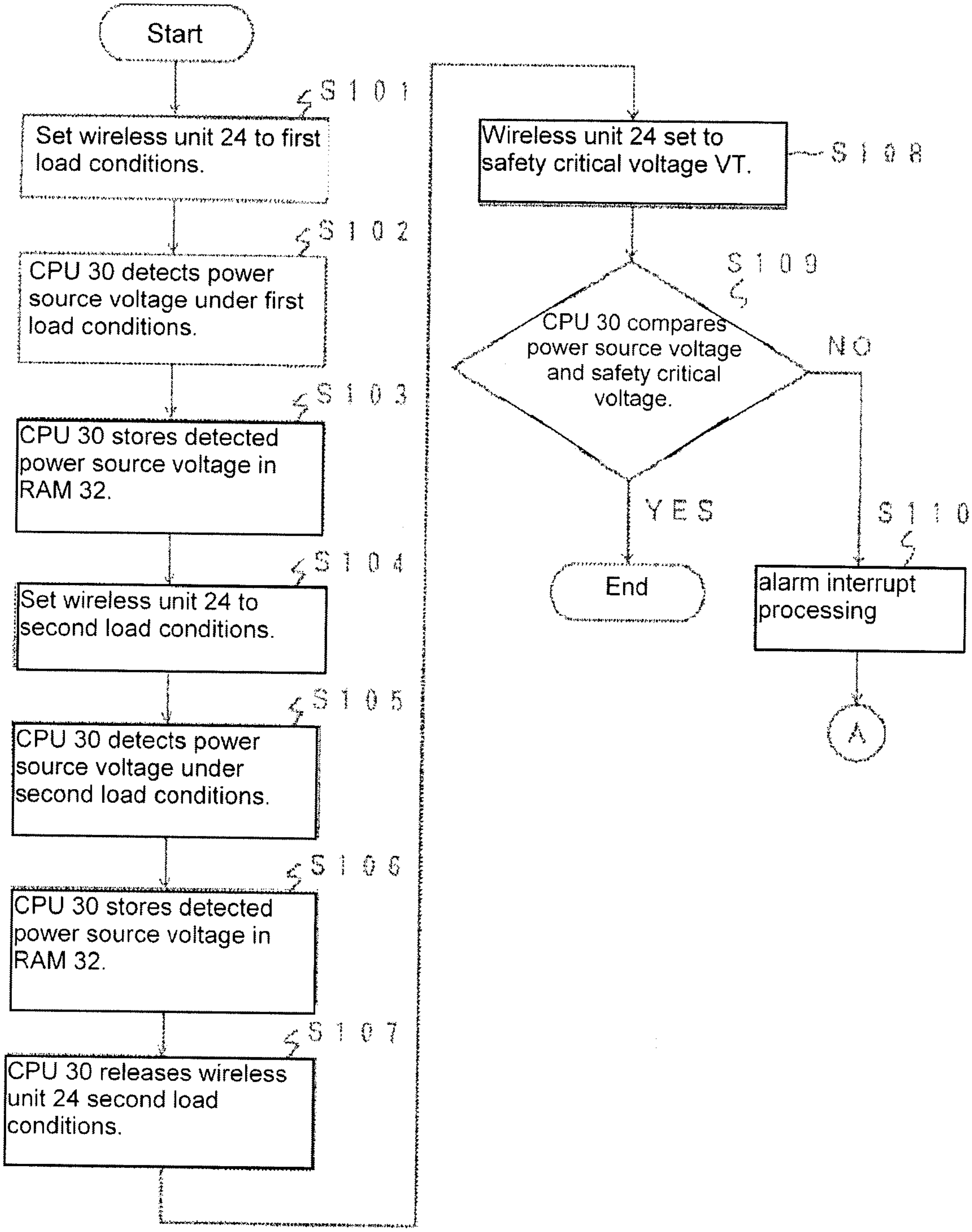

Start
S101
Set wireless unit 24 to first load conditions.
S102
CPU 30 detects power source voltage under first load conditions.
S103
CPU 30 stores detected power source voltage in RAM 32.
S104
Set wireless unit 24 to second load conditions.
S105
CPU 30 detects power source voltage under second load conditions.
S106
CPU 30 stores detected power source voltage in RAM 32.
S107
CPU 30 releases wireless unit 24 second load conditions.
Wireless unit 24 set to safety critical voltage VT.
S108
S109
CPU 30 compares power source voltage and safety critical voltage.
NO
YES
End
S110
alarm interrupt processing
A

FIG. 3

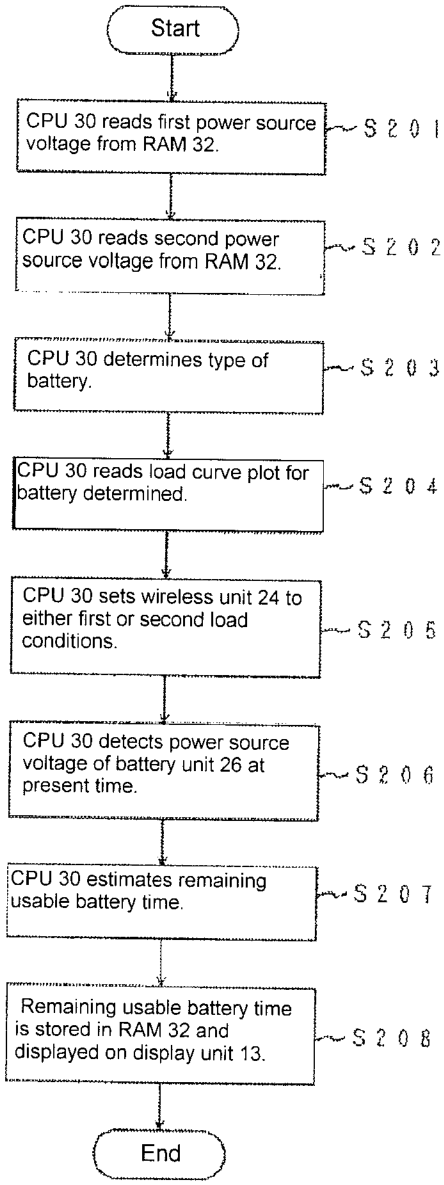
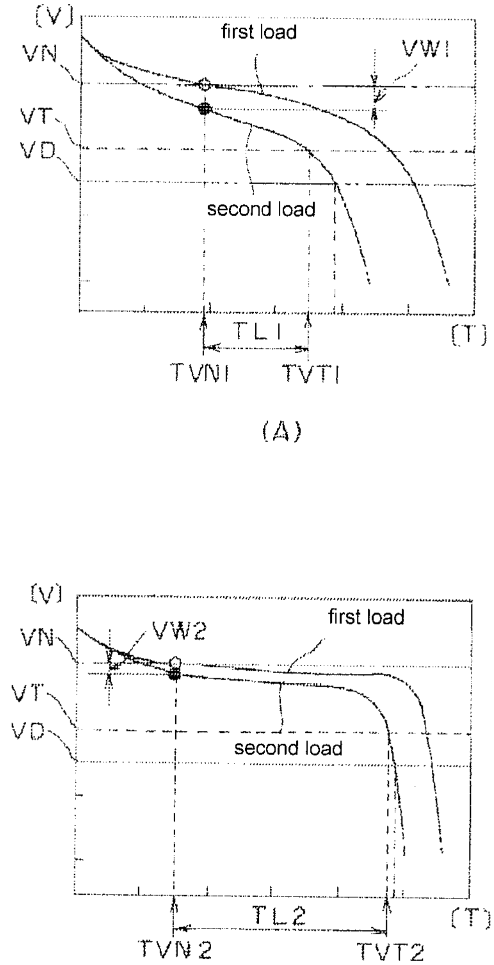

Start
CPU 30 reads first power source voltage from RAM 32.
S 2 0 1
CPU 30 reads second power source voltage from RAM 32.
S 2 0 2
CPU 30 determines type of battery.
S 2 0 3
CPU 30 reads load curve plot for battery determined.
S 2 0 4
CPU 30 sets wireless unit 24 to either first or second load conditions.
S 2 0 5
CPU 30 detects power source voltage of battery unit 26 at present time.
S 2 0 6
CPU 30 estimates remaining usable battery time.
S 2 0 7
Remaining usable battery time is stored in RAM 32 and displayed on display unit 13.
S 2 0 8
End

FIG. 4


(V)
first load
VW1
VN
VT
VD
second load
TL1
(T)
TVN1
TVT1
(A)
(V)
VW2
first load
VN
VT
VD
second load
TL2
(T)
TVN2
TVT2

(B)

FIG. 5

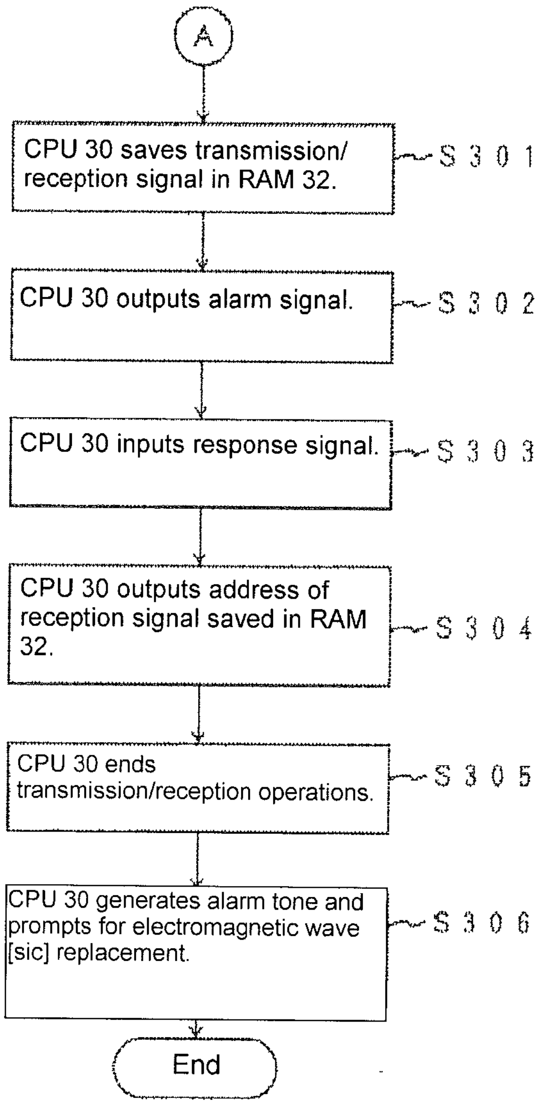
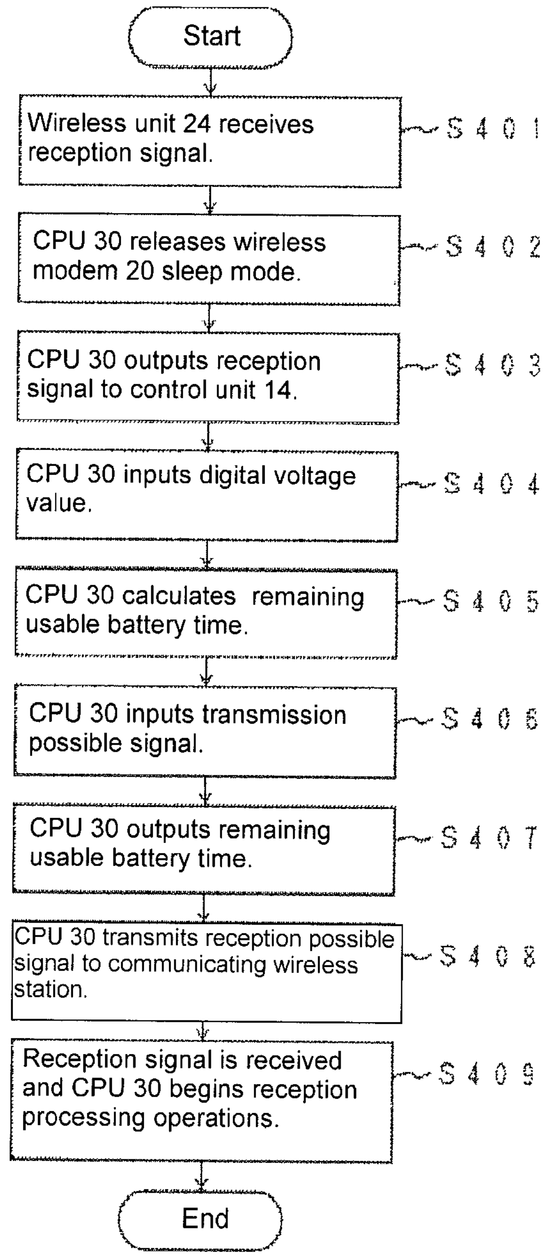
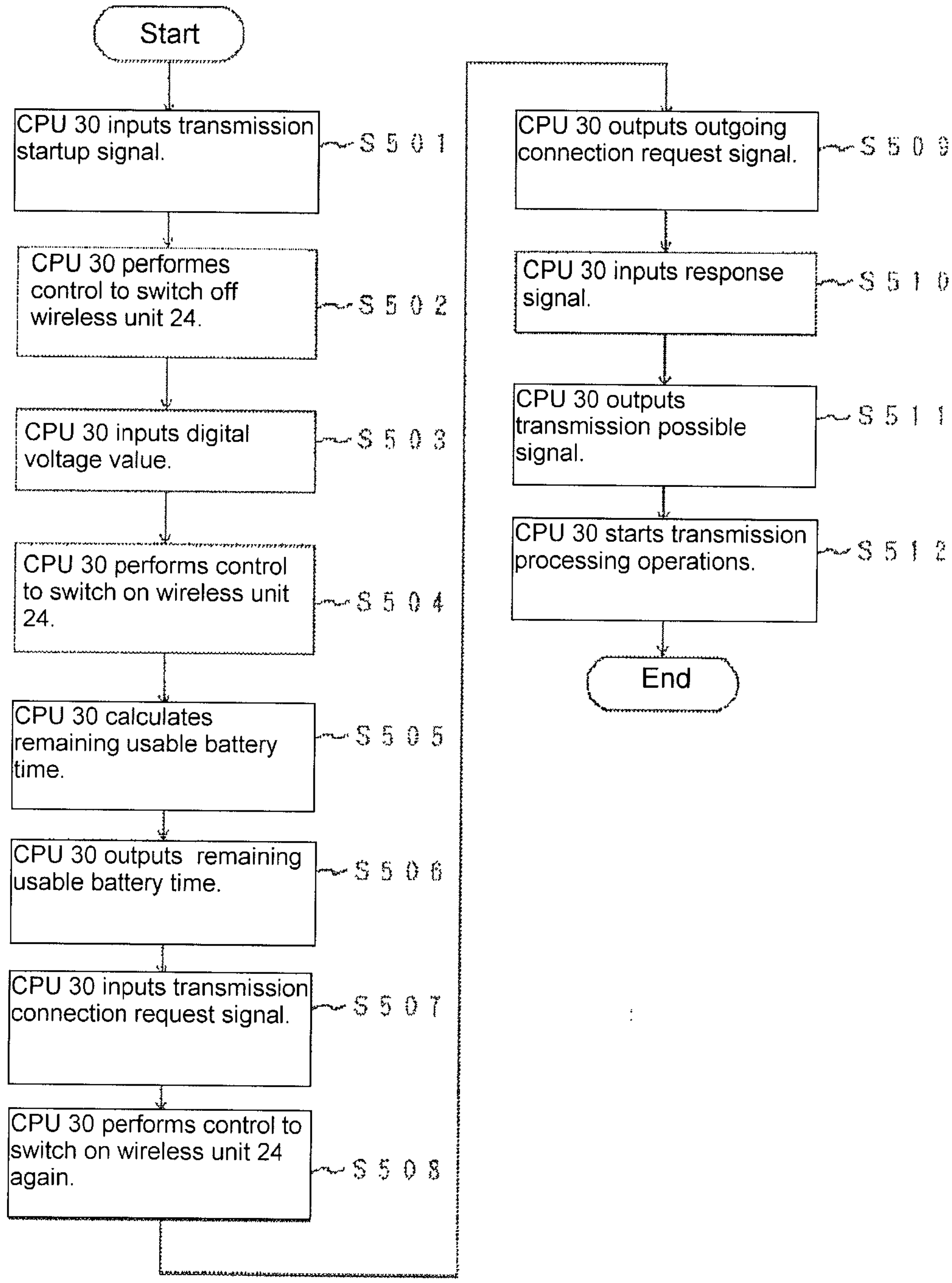

A
CPU 30 saves transmission/ reception signal in RAM 32.
S301
CPU 30 outputs alarm signal.
S302
CPU 30 inputs response signal.
S303
CPU 30 outputs address of reception signal saved in RAM 32.
S304
CPU 30 ends transmission/reception operations.
S305
CPU 30 generates alarm tone and prompts for electromagnetic wave [sic] replacement.
S306
End

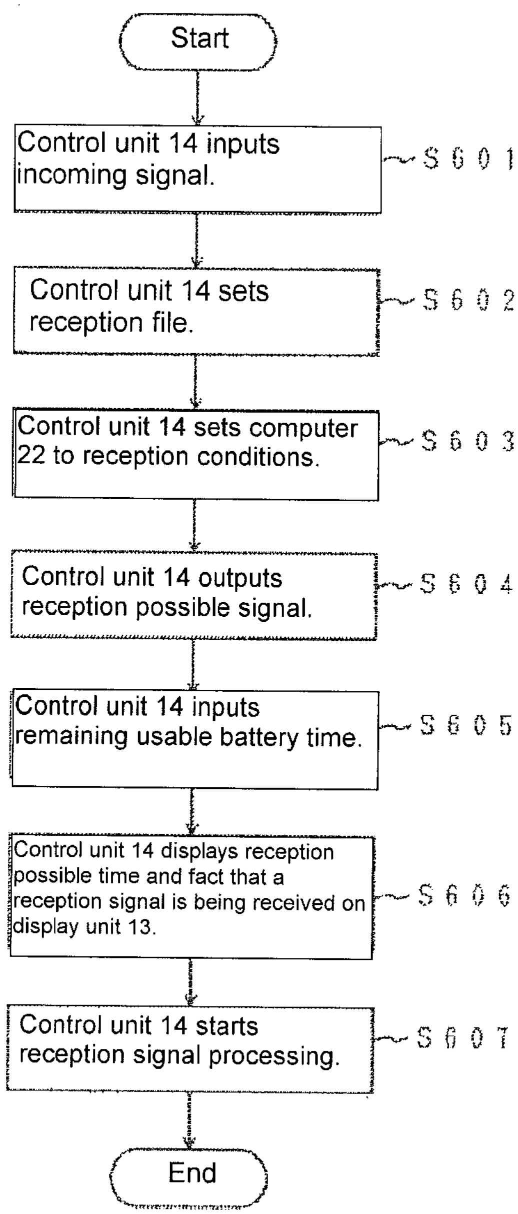
FIG.6]


Start
Wireless unit 24 receives reception signal.
S401
CPU 30 releases wireless modem 20 sleep mode.
S402
CPU 30 outputs reception signal to control unit 14.
S403
CPU 30 inputs digital voltage value.
S404
CPU 30 calculates remaining usable battery time.
S405
CPU 30 inputs transmission possible signal.
S406
CPU 30 outputs remaining usable battery time.
S407
CPU 30 transmits reception possible signal to communicating wireless station.
S408
Reception signal is received and CPU 30 begins reception processing operations.
S409
End

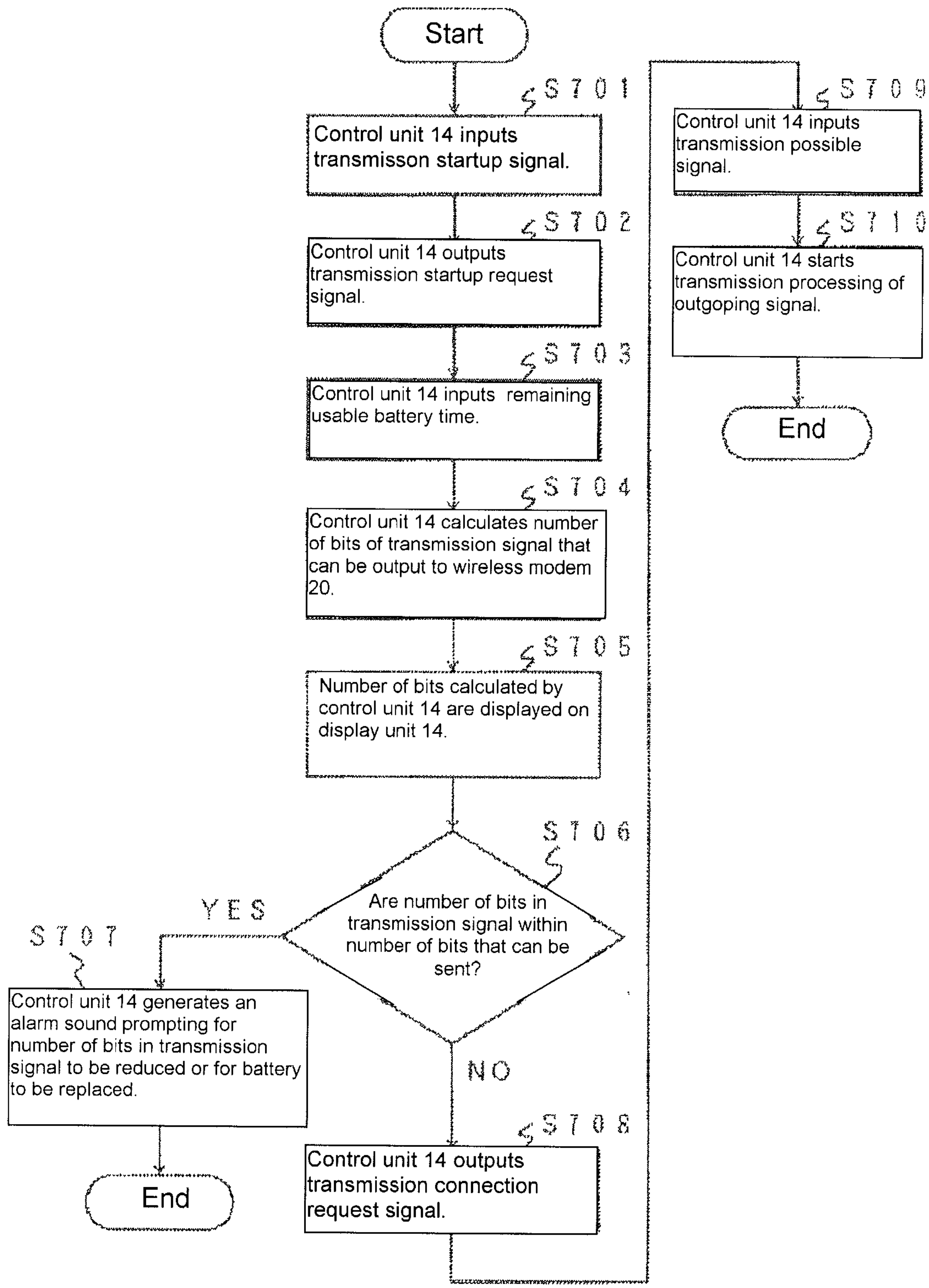
[FIG. 7]


Start
CPU 30 inputs transmission startup signal.
S501
CPU 30 performes control to switch off wireless unit 24.
S502
CPU 30 inputs digital voltage value.
S503
CPU 30 performs control to switch on wireless unit 24.
S504
CPU 30 calculates remaining usable battery time.
S505
CPU 30 outputs remaining usable battery time.
S506
CPU 30 inputs transmission connection request signal.
S507
CPU 30 performs control to switch on wireless unit 24 again.
S508
CPU 30 outputs outgoing connection request signal.
S509
CPU 30 inputs response signal.
S510
CPU 30 outputs transmission possible signal.
S511
CPU 30 starts transmission processing operations.
S512
End

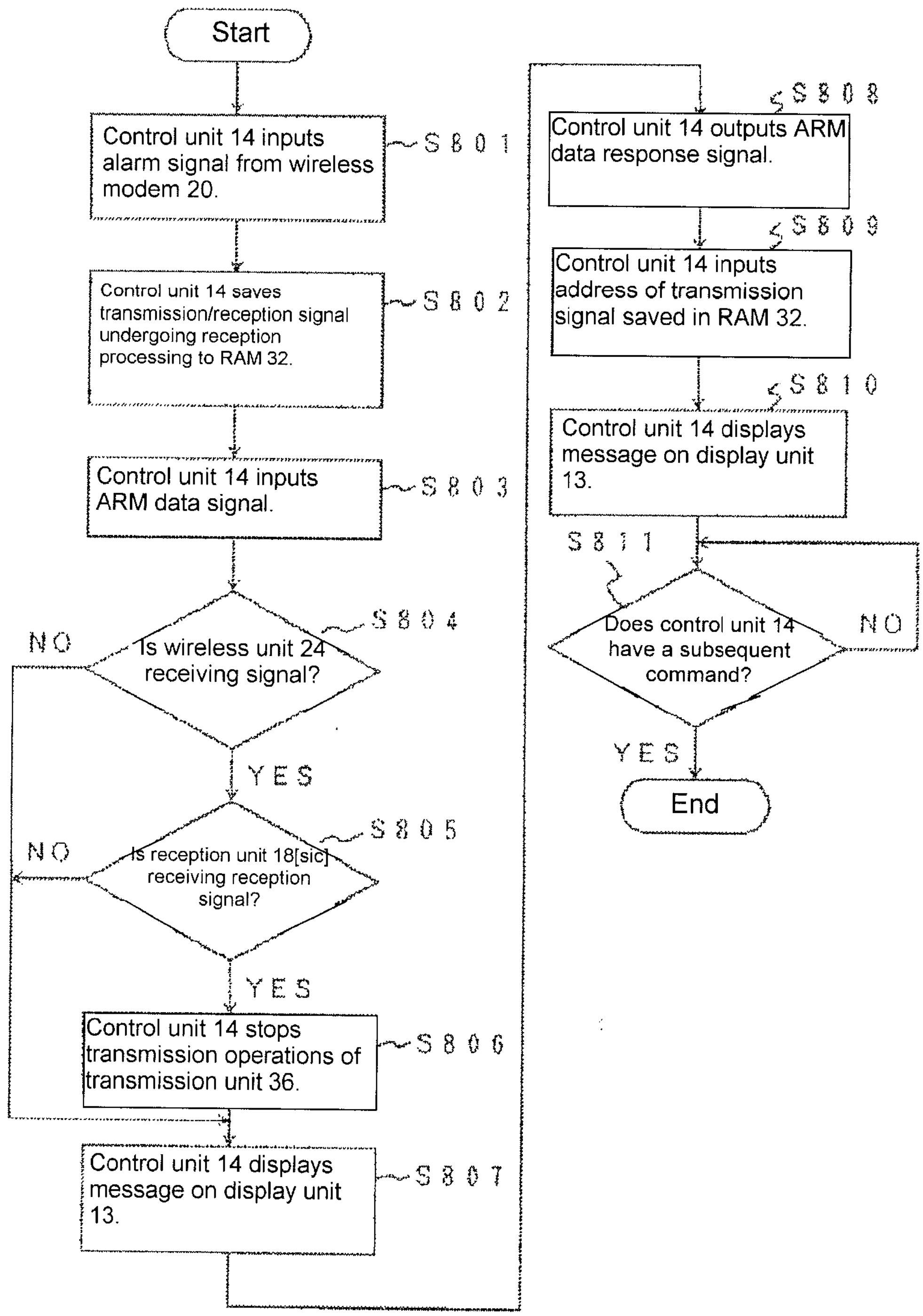
[FIG. 8]


Start
Control unit 14 inputs incoming signal.
S601
Control unit 14 sets reception file.
S602
Control unit 14 sets computer 22 to reception conditions.
S603
Control unit 14 outputs reception possible signal.
S604
Control unit 14 inputs remaining usable battery time.
S605
Control unit 14 displays reception possible time and fact that a reception signal is being received on display unit 13.
S606
Control unit 14 starts reception signal processing.
S607
End

[FIG. 9]


Start
S701
Control unit 14 inputs transmisson startup signal.
S702
Control unit 14 outputs transmission startup request signal.
S703
Control unit 14 inputs remaining usable battery time.
S704
Control unit 14 calculates number of bits of transmission signal that can be output to wireless modem 20.
S705
Number of bits calculated by control unit 14 are displayed on display unit 14.
S706
Are number of bits in transmission signal within number of bits that can be sent?
YES
S707
Control unit 14 generates an alarm sound prompting for number of bits in transmission signal to be reduced or for battery to be replaced.
End
NO
S708
Control unit 14 outputs transmission connection request signal.
S709
Control unit 14 inputs transmission possible signal.
S710
Control unit 14 starts transmission processing of outgoping signal.
End

[FIG. 10]



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(51) Int. Cl.[6]		Identification Code	Internal File No.	FI	Technical Indic.
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H 0 4 L	29/10				